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Report Documentation Page			Form Approved OMB No. 0704-0188	
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1. REPORT DATE 01 JUN 2008	2. REPORT TYPE N/A	3. DATES COVERED -		
4. TITLE AND SUBTITLE Modeling PMESII Factors to Support Strategic Education			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army War College			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited				
13. SUPPLEMENTARY NOTES See also ADM202527. Military Operations Research Society Symposium (76th) Held in New London, Connecticut on June 10-12, 2008, The original document contains color images.				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	18. NUMBER OF PAGES 28	19a. NAME OF RESPONSIBLE PERSON



Modeling PMESII* Factors to Support Strategic Education

11 June 2008

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*Political, Military, Economic, Social, Information, and Infrastructure

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Agenda

- ▶ Introduction
- ▶ M&S Steering Committee / JFCOM PMESII initiative
- ▶ Strategic Education at the Army War College
- ▶ PMESII Modeling Support
- ▶ An Approach to PMESII
- ▶ Way Ahead & Conclusion

Disclaimer: The views expressed in this presentation are those of the authors and do not necessarily reflect the official policy or position of the Army, Department of Defense, or the U.S. Government

Briefing Purposes

- ▶ Inform the MORS community of
 - PMESII modeling relevant to current operational environment
 - PMESII inclusion in U.S. Army War College (USAWC) capstone
 - PMESII modeling trial at USAWC
- ▶ Encourage PMESII community

Introduction

- ▶ DIME / PMESII / Irregular Warfare modeling
 - Extremely important field... in infancy
 - Reflects operational environment
- ▶ USAWC Strategic Education can leverage emerging work
 - JFCOM work-in-progress (next slides)
 - M&S to enhance scenario credibility and highlight learning points
- ▶ Suitability for scenario development or COCOM planning
- ▶ Continue investigation

DoD M&S Steering Committee Sponsored Effort Coordinated by USJFCOM

Objective: Prototype a dynamically updating web-enabled environment supporting comprehensive DIME/PMESII modeling and simulation, *robust enough to support Course of Action (COA) development / analysis*

- Develop linkage between the Integrated Gaming System (IGS) and the Synthetic Environments for Analysis and Simulation (SEAS)
- Demonstrate and employ the prototype PMESII environment
 - USMC Command and Staff College Nine Innings Exercise
 - US Army War College Strategic Decision-Making Exercise
- Document approach, lessons learned in peer-reviewed settings
 - Spring 2007 Simulation Interoperability Workshop
 - 12th International CCRTS
 - MODSIMWORLD
 - ➡ 76th MORS Symposium (June 2008)

M&S SC / JFCOM Motivation

Effort to develop a web-enabled PMESII federation was motivated by a number of common cross cutting desires:

- ▶ Address common M&S gap to improve PMESII Modeling and Simulation (M&S) in the 21st century operational environment
- ▶ Address USCENTCOM request for USJFCOM assessment of 4th Generation Warfare/PMESII M&S tools that can support operational decision-making in the GWOT
- ▶ Investigate feasibility and cost savings associated with distributed PMESII M&S integration, testing, and execution via internet
- ▶ Investigate utility of PMESII M&S in schoolhouse environments and in support of planning and decision making efforts including HLD/HLS/Unified Action
- ▶ Take a first step toward establishing a PMESII Center of Excellence

United States Army War College

Mission

- To prepare selected military, civilian, and international leaders for the responsibilities of strategic leadership;
- To educate current and future leaders on the development and employment of landpower in a joint, interagency, intergovernmental and multinational environment;
- To research and publish on national security and military strategy;
- To engage in activities that support the Army's strategic communication efforts.



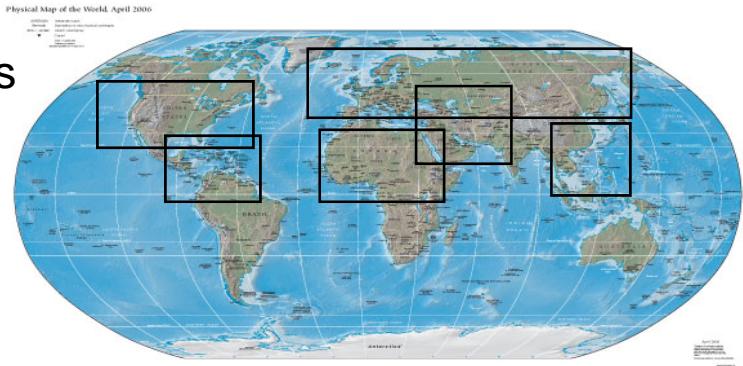
Strategic Decision Making Exercise (SDME)

- Annual capstone political-military experiential wargame
- Reinforces core curriculum with simulated senior leader experience

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Strategic Decision Making Exercise

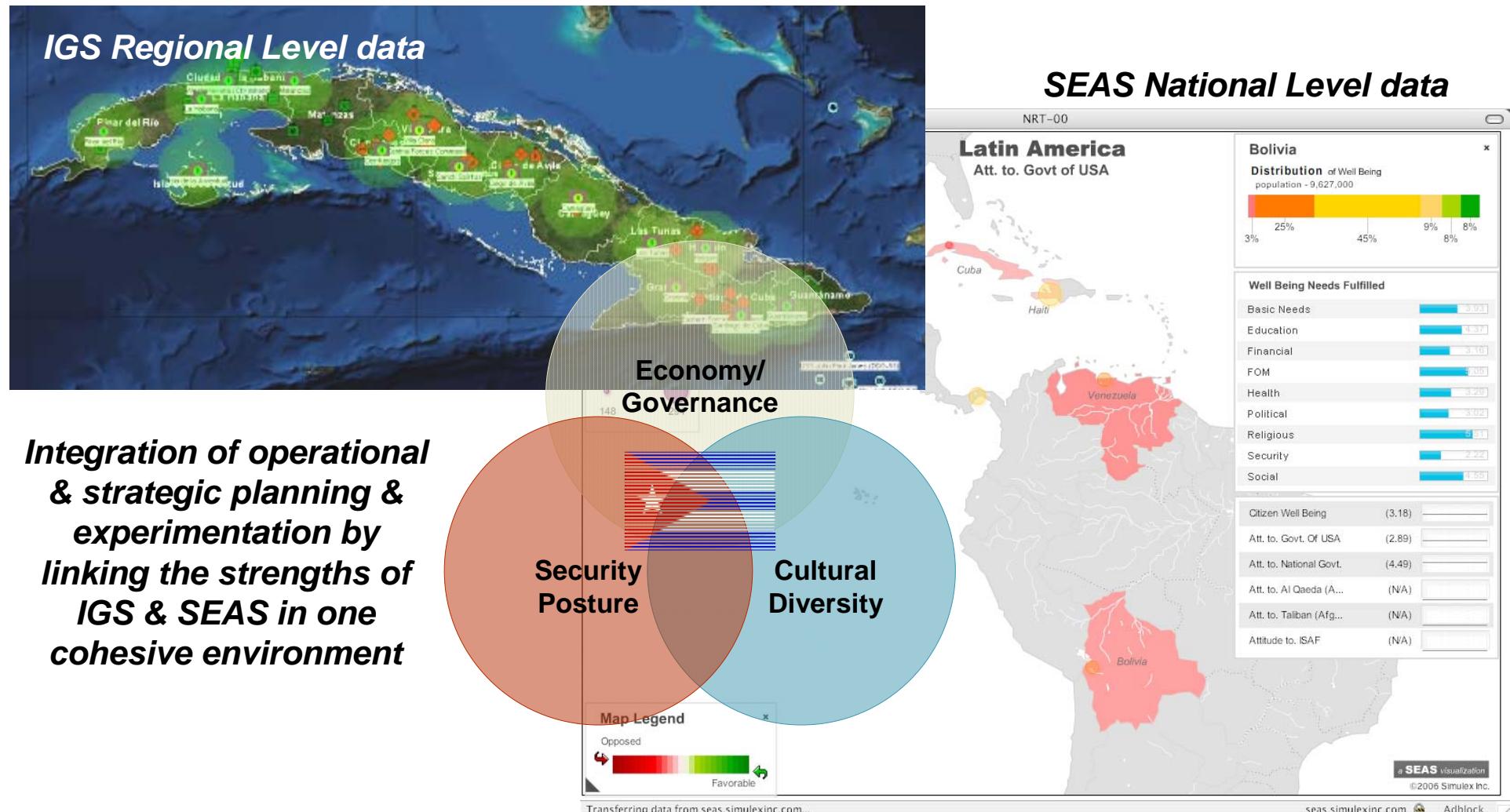
- ▶ Reinforces Joint, Interagency, Intergovernmental, and Multinational processes
 - **Strategic Level Capstone**
 - Complex future (2021) environment with 7 sub-scenarios
 - Robust **PMESII play**
 - Strategic force structure – students role-play senior leader positions
 - News, interviews, testimony
 - MSELs, constructive simulation, custom tools, SME's create a **credible environment**
 - Detailed SME scenario authoring
 - Scripted master scenario event list (MSEL)
 - Selected combat and transportation models
 - Current SDME process works... inject change with care
 - Focus: **Student learning experience**... not technology!
- ▶ **Question: Can we use emerging PMESII analysis and decision support capabilities to enhance the student experience?**



Requirement Identification & PMESII Modeling Search

- ▶ Student education focus & existing exercise cycle... augmentation must:
 - **Do no harm**...may not distract from ongoing exercise cycle
 - Implement running start
- ▶ Scenario authors: pursue PMESII trial: **notional educational Cuba scenario**
- ▶ Several emerging PMESII decision support aids
 - USJFCOM-sponsored Integrated Gaming System (IGS)- Synthetic Environments for Analysis and Simulation (SEAS) Federation
 - Army's Joint Non-Kinetic Effects Model (JNEM)
 - Northrop Grumman's Civil Effects Leadership Training Simulation (CELTs)
 - Joint Staff J8 Irregular Warfare system dynamics framework
- ▶ Asked M&S Coordination Office WRT USAWC requirements -> USJFCOM
- ▶ Established no-cost partnership with USJFCOM.
 - Goal: **explore PMESII analysis and decision support aids use for strategic education**
- ▶ Other efforts still interesting... **plenty of room for multiple approaches**

Linkage of IGS and SEAS in Support of U.S. Army War College Strategic Decision Making Exercise

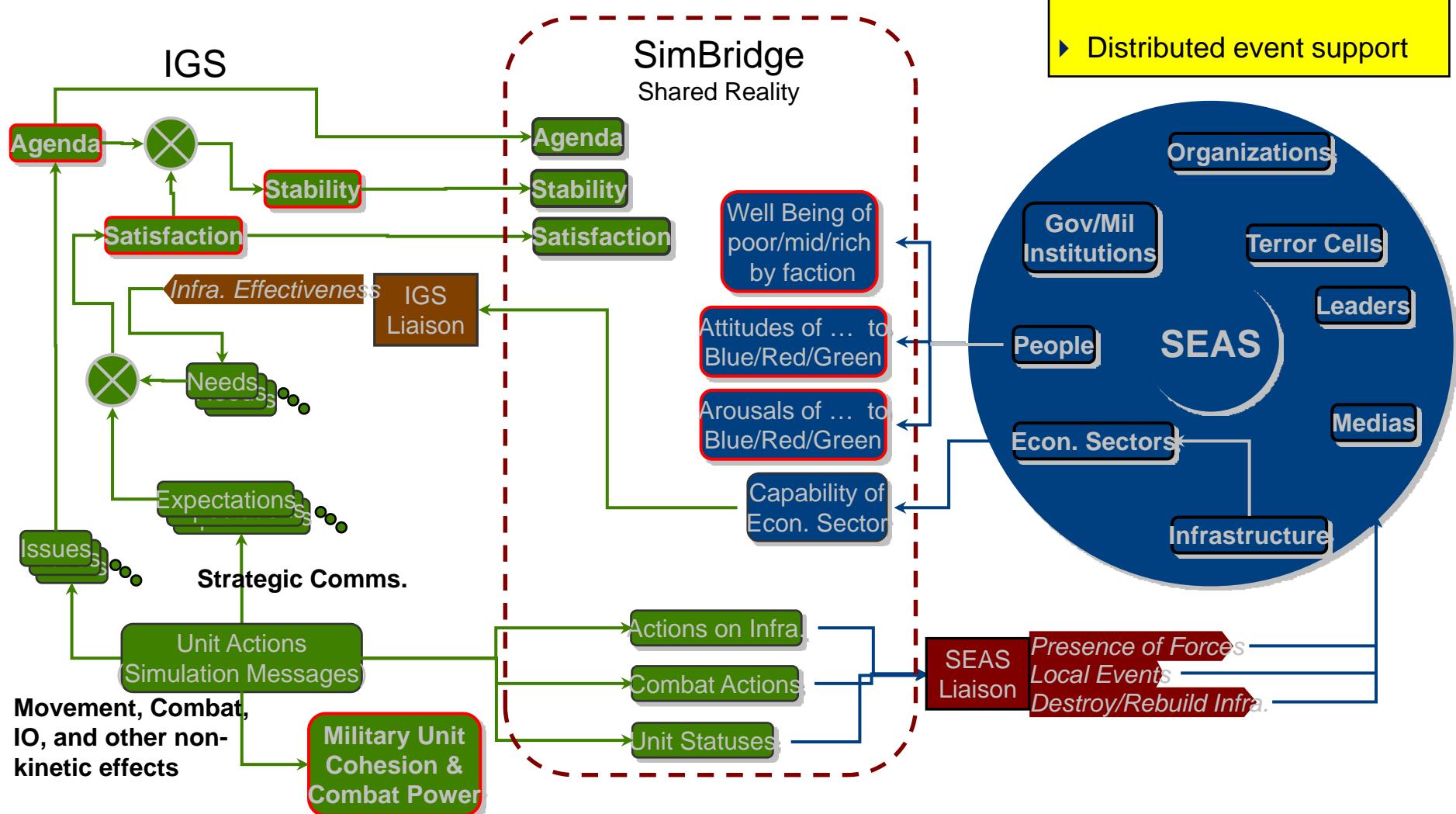


Integration of operational & strategic planning & experimentation by linking the strengths of IGS & SEAS in one cohesive environment

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PMESII M&S Run-Time Integration Approach / Semantic Mapping

- ▶ Distributed M&S development and testing over the internet – *a first for USJFCOM*
- ▶ Distributed event support



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Runtime Integration of SEAS & IGS Implemented through SimBridge

-
- IGS *shares with* Shared Reality:
- Locations of military units
 - Actions performed by military units
 - Soldiers wounded or killed in combat
 - Actions on infrastructure, such as repairs to the power infrastructure in a region
- SEAS *leverages from* Shared Reality:
- The presence & size of military (& insurgent) forces influences the security & freedom of movement of individuals in an area
 - Deaths & injuries of military forces, which can impact people's perceptions of the various sides as well as their perception of security
 - Actions to rebuild or destroy infrastructure, which have an indirect influence on a region's economy & a ripple effect on economies that depend on the products of the infrastructure
- IGS *leverages from* Shared Reality:
- Economic statistics emerging from the global economy in SEAS-VIS
 - Economy statistics are used to aid in computing key metrics of stability, agenda, and satisfaction in IGS that are based on the needs and expectations of populations
 - SEAS Metrics for visualization in context of other scenario specific geospatial information and for correlation with other IGS metrics
- SEAS *shares with* Shared Reality:
- Population behavior statistics
 - The size, well being, & public opinions of population classes in each geographical region (country level in this case)
 - A representation of an emergent economy
 - Production levels of economic sectors in each geographical region being studied (country level in this case)

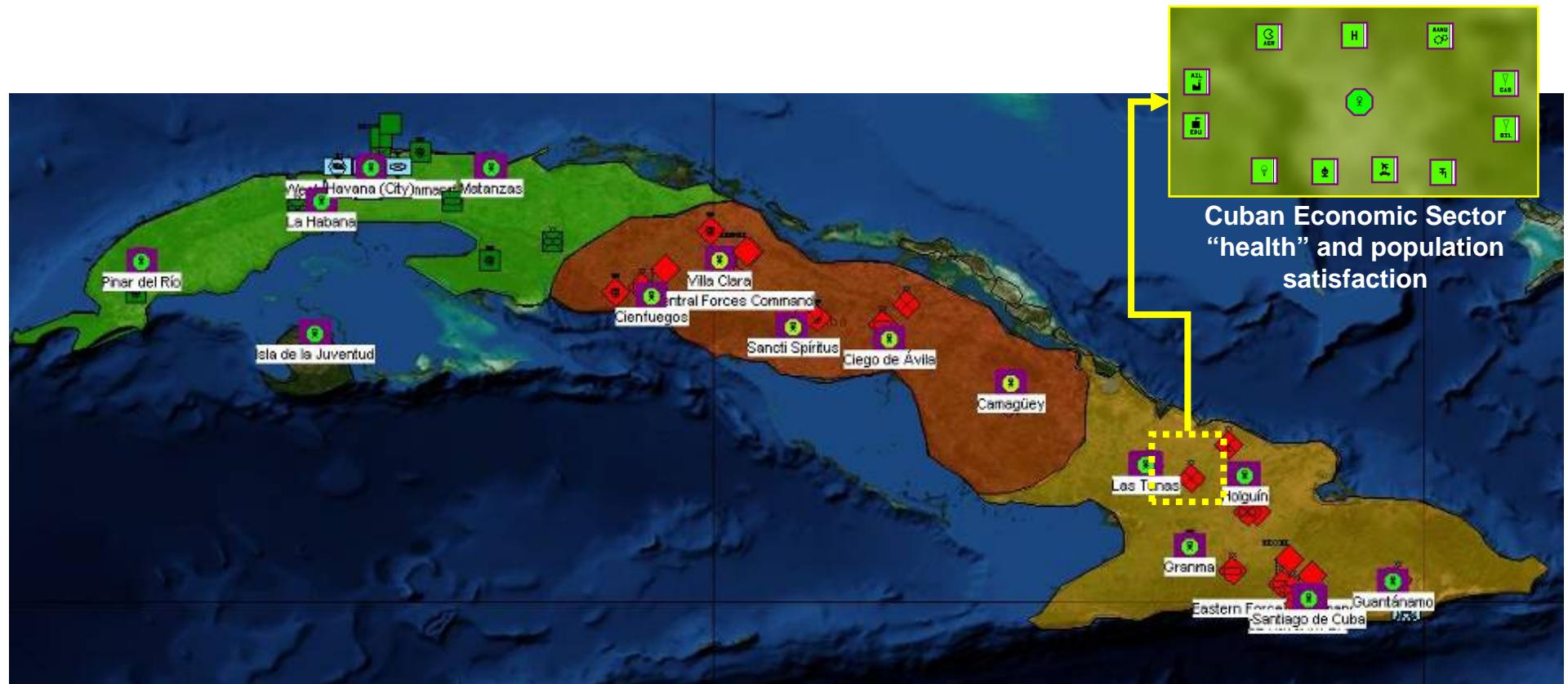
Scenario Creation, Model Settings, & Courses of Action

- ▶ Sept 2007: Authoring mostly complete – notional post-Castro 2021 educational scenario
 - PMESII capability brief
 - JFCOM and USAWC had independent Cuba representations
 - Provided scenario documentation
- ▶ Iterative “brief – model – brief” - art of the possible
- ▶ Focus:
 - Economic production for selected sectors
 - Well-being: selected infrastructure – water, telecom, health care
 - Attitudes & political affiliation by population sector
- ▶ PMESII developers augmented existing notional Cuba 2021 scenario to match USAWC starting conditions
 - Internal fighting leaves varying conditions country-wide
 - Internally-displaced persons
- ▶ Selected 3 courses of action for Security, Stabilization & Reconstruction Operations
 - US leads
 - UN or OAS leads
 - Cubans left to recover alone
- ▶ Course of Action (COA) analysis w/ PMESII model

PMESII Model Runs & Output Analysis

- ▶ One of 7 scenarios that comprised the SDME POI
 - Notional post – Castro 2021 Cuba (factional fighting – horrible conditions; SSTRO necessary)
- ▶ Start conditions: PMESII modelers enhanced existing notional Cuba scenario to match USAWC
 - Little additional work for USAWC – provided existing MSELs, maps, documents
 - Reused existing environments developed in IGS/SEAS as part of other DoD work or internal development
- ▶ PMESII scenario & capability backbrief
 - Metrics: **economy, population attitudes, regional stability per notional 2021 scenario**
 - Confirmation of start conditions
 - **COA selection**
- ▶ Output analysis
 - Intuitive graphs and geospatial metric overlays
 - Insights supported learning points
 - Start coalition building early
 - Rapid early application of SSTRO resources
 - Hard to change public attitudes
 - Need robust strategic communication campaign
 - Additional PMESII investigations could reveal emergent patterns or other “ah-ha’s”

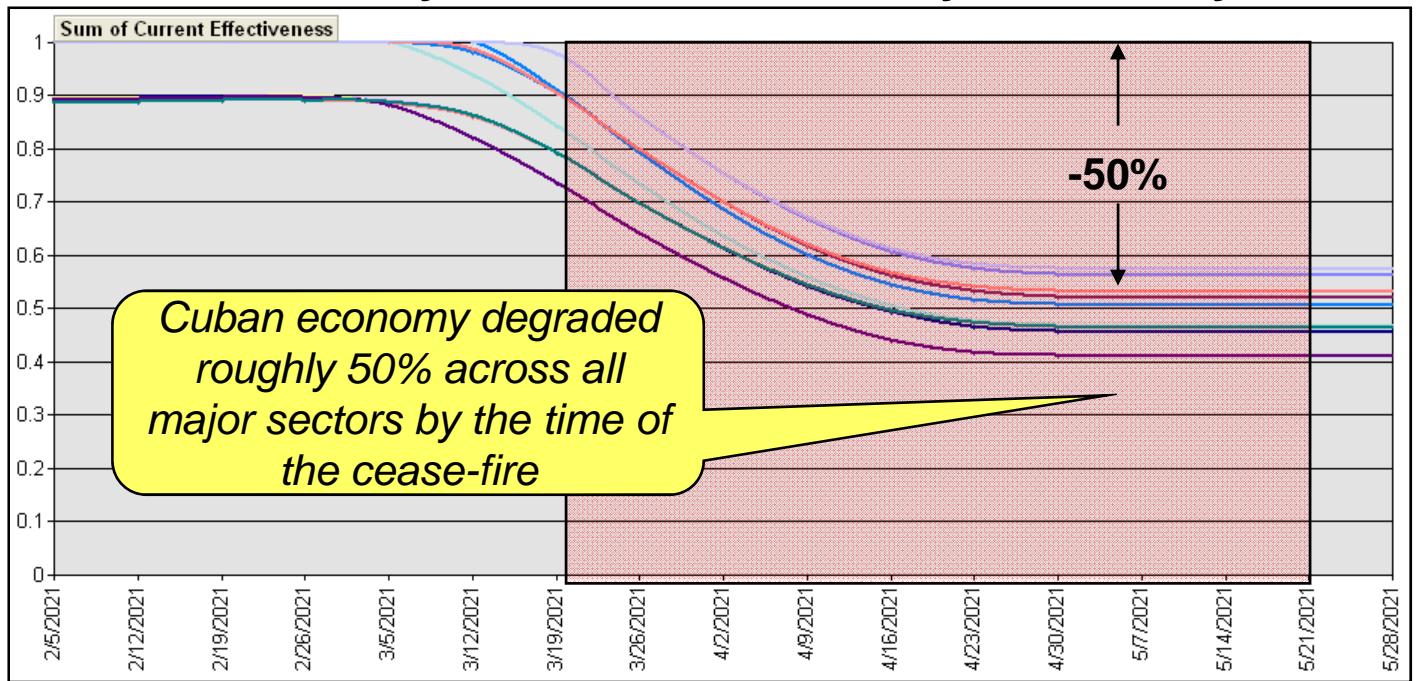
Starting Conditions: Regional Support for Ruling Government - 22 Mar 2021



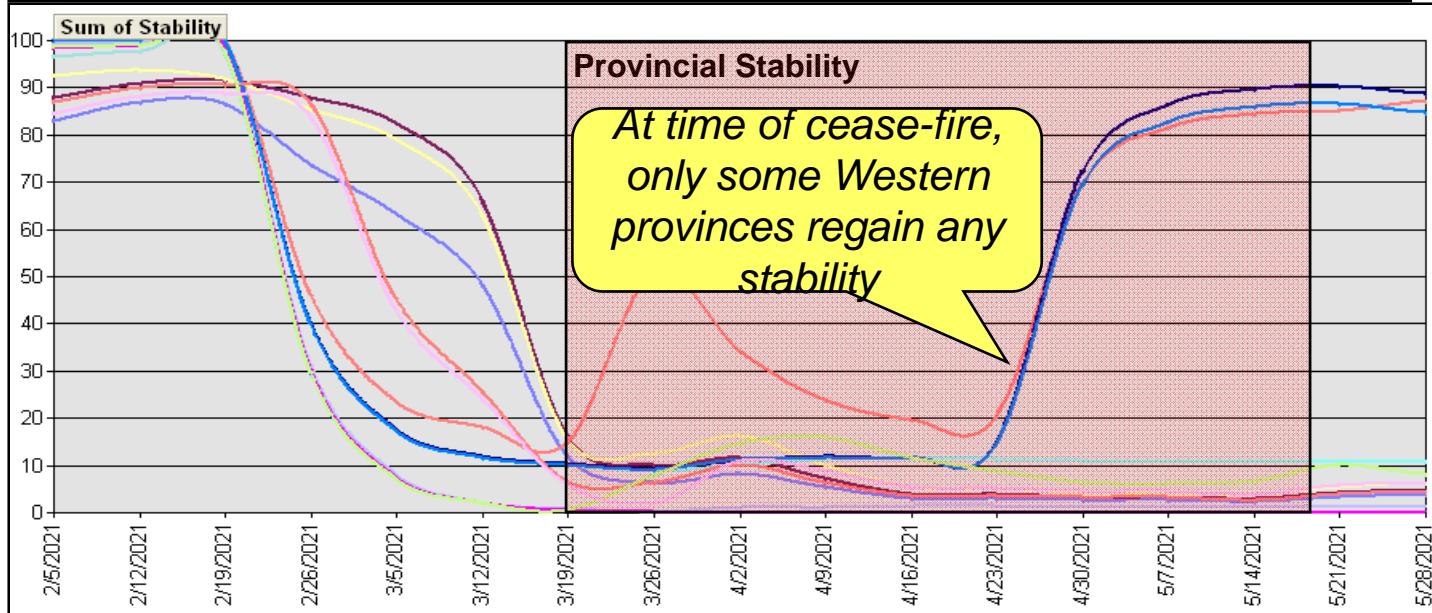
- **Central Cuban regions largely opposed to ruling Government.**
- **Eastern Cuban regions also opposed but somewhat more room for influencing attitudes through actions.**

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Cuban Economy / Provincial Stability Mar – May 2021



Agriculture, Cienfuegos [325-9]
Agriculture, Havana (City) [325-9]
Agriculture, Santiago de Cuba [325-9]
Health, Cienfuegos [325-12]
Health, Havana (City) [325-12]
Health, Santiago de Cuba [325-12]
Manufacturing, Cienfuegos [325-8]
Manufacturing, Havana (City) [325-8]
Manufacturing, Santiago de Cuba [325-8]
Power, Cienfuegos [325-2]
Power, Havana (City) [325-2]
Power, Santiago de Cuba [325-2]
Telecom, Cienfuegos [325-4]
Telecom, Havana (City) [325-4]
Telecom, Santiago de Cuba [325-4]
Transportation, Cienfuegos [325-7]
Transportation, Havana (City) [325-7]
Transportation, Santiago de Cuba [325-7]
Water, Cienfuegos [325-5]
Water, Havana (City) [325-5]
Water, Santiago de Cuba [325-5]



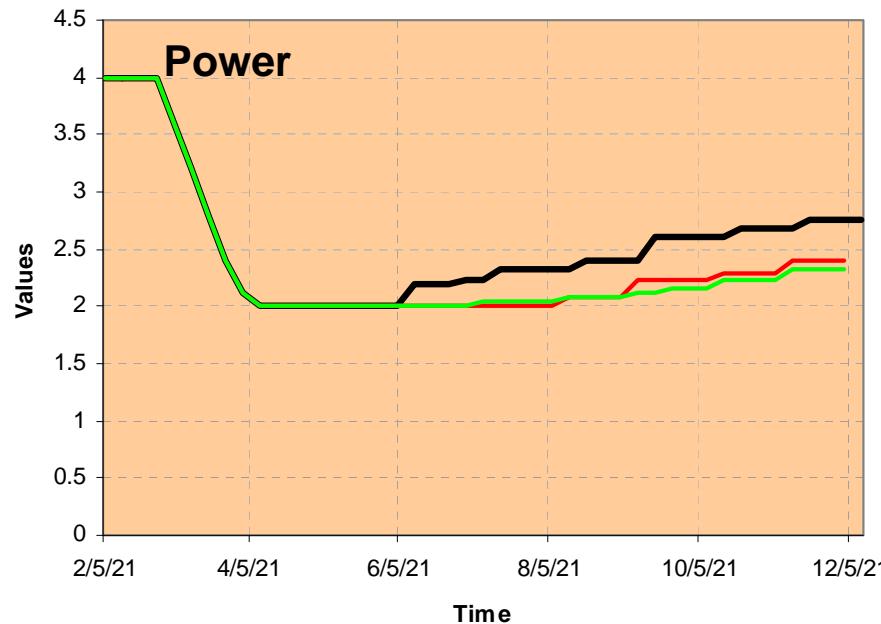
Camaguey [325-4]
Ciego de Avila [325-4]
Cienfuegos [325-4]
Granma [325-4]
Guananamo [325-4]
Havana (City) [325-4]
Holguin [325-4]
Isla de la Juventud [325-4]
La Habana [325-4]
Las Tunas [325-4]
Matanzas [325-4]
Pinar del Rio [325-4]
Sancti Spiritus [325-4]
Santiago de Cuba [325-4]
Villa Clara [325-4]

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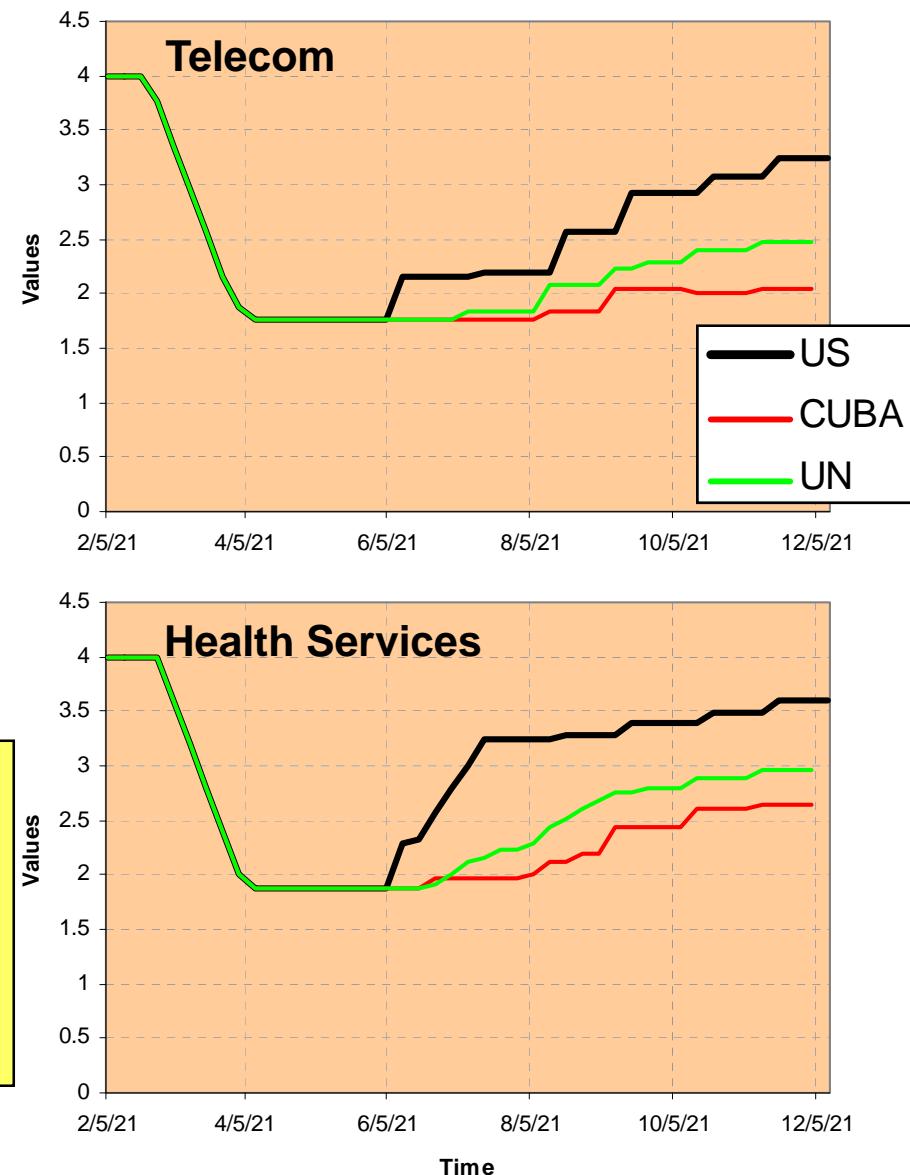
Cuban Infrastructure Status Feb – Dec 2021

0=Destroyed

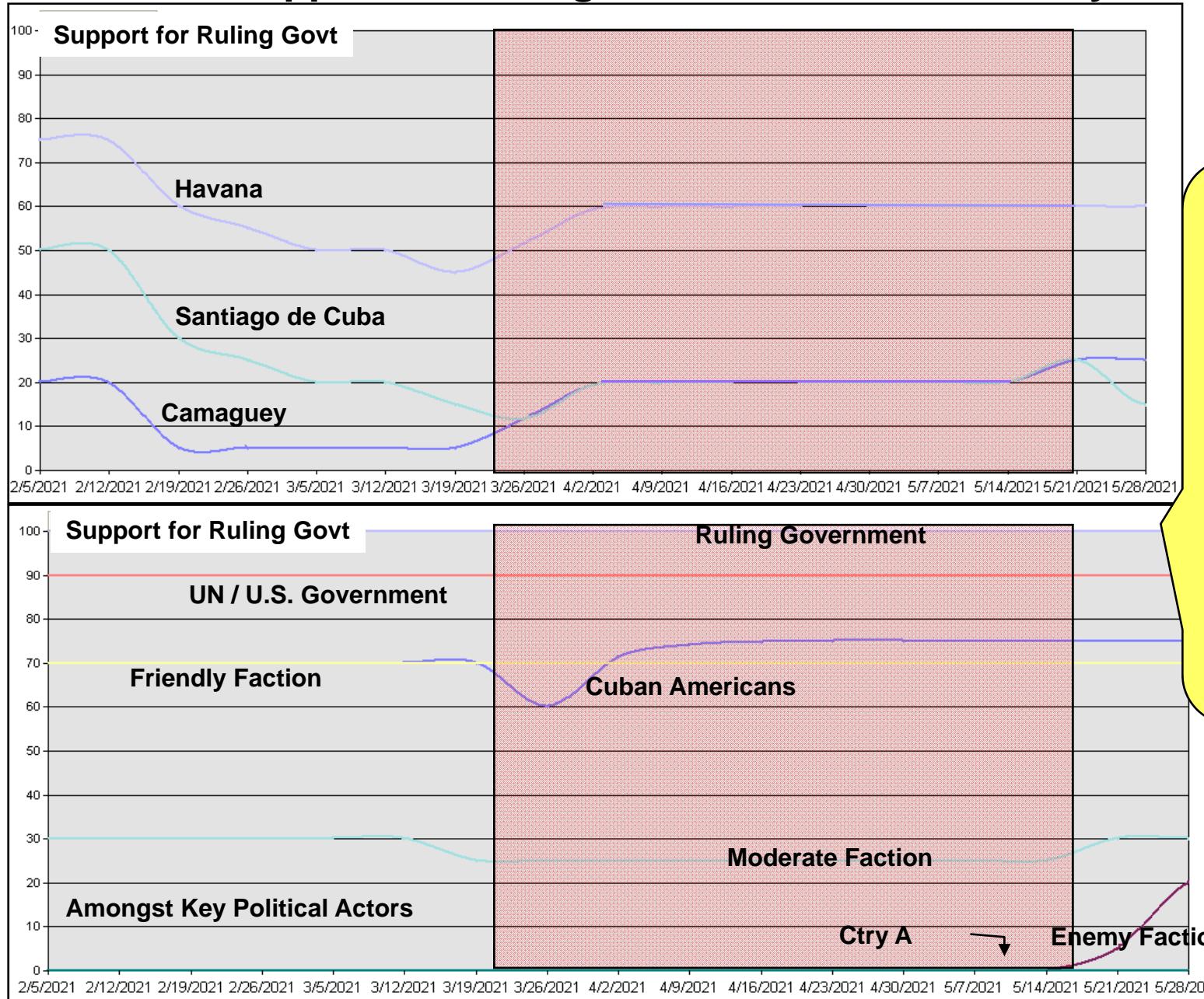
4=Operating at pre-conflict levels



Rebuilding efforts, especially U.S.-led efforts, increase infrastructure capability/capacity more rapidly. SSTRO Coalition-building efforts must begin early to minimize the lag (and thus close the gap) caused by capability/capacity gaps and time-distance issues.



Support for Ruling Government March – May 2021



Support for the ruling government falls during combat operations, and then support increases among most populations as combat drags on and the cease fire comes

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PMESII Impact for Strategic Education

- ▶ Exercise designers and scenario authors “got it.”
- ▶ PMESII models
 - Reinforced scenario credibility
 - Independently produced COA results consistent with learning points
 - Did not (yet) lead to groundbreaking ah-ha’s
 - Results on the order of current combat models and transportation models
 - **Able to lend scenario credibility to this exercise, and potential for added credibility in future iterations**
- ▶ During-exercise
 - Briefed in-context PMESII modeling results to notional SOUTHCOM reps
 - Some “got it.”
 - Pace of the exercise made consumption of a new form of modeling & analysis challenging
 - Controllers engaged in PMESII discussion, but did not pass modeling output to students
 - Controllers & students gravitated to combat aspects
- ▶ Thoughts
 - SEAS/IGS work for **pre-exercise scenario authoring support**
 - Similarly, would support **COCOM planning phase**
 - Could be used during exercise, or for real-world crisis action planning... work responsiveness!
 - **Users need more exposure**
 - Do we need a new set of **PMESII icons & control measures?**
 - **If we can draw it, we can understand it**

Assessment

- ▶ BLUF: **Definitely worth continued investigation**
- ▶ Cost - No cost to USAWC for this trial
- ▶ Benefits
 - **Scenario credibility from PMESII models**
 - Output products highlight selected learning objectives
- ▶ Ease of use
 - Very easy for USAWC
 - PMESII developers transformed existing products into simulation representation and provided initial analysis
- ▶ Relevance of metrics
 - **Economy, public attitudes, and stability indicators**
 - Consistent with **FM 3-24**, as well as Joint Staff Irregular Warfare system dynamics diagrams
 - In future iterations, add detail from region to region, or faction to faction
- ▶ Consumability of Output
 - **Time-based graphs** for key metrics easily consumed with key event callouts explaining causality
 - **Map-based products** worked well
 - **Multi-axis graphs** took more time to understand
 - **Political will dashboard charts** made sense given brief explanation
 - Developing common PMESII output **presentation methods** would enable at-a-glance intake

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Way Ahead

- ▶ USAWC Center for Strategic Leadership willing to continue PMESII / DIME / Irregular Warfare modeling exploration
 - At no / low cost
 - Start earlier in scenario authoring process and iterate
 - Explore presentation methods... PMESII icons, control measures, graphs
 - Inject selected analytical output products with controllers & students
 - Web-based access to PMESII services is an innovative approach attractive to USAWC and may have utility to other users who lack the resources to host their own IGS/SEAS environment
- ▶ Propose community of interest to share lessons learned from schoolhouse implementations of PMESII modeling
 - Leverage opportunities via JFCOM PMESII Center of Excellence

Conclusions

- ▶ DIME / PMESII / Irregular Warfare modeling
 - Extremely important field... in infancy
 - Reflective of operational environment
- ▶ USAWC Strategic Education can leverage emerging modeling work
- ▶ Runtime integration of IGS and SEAS enhanced scenario credibility and highlighted learning points
- ▶ This mode of model employment is well-suited for scenario development in support of strategic education
 - Also, recommended for training or COCOM adaptive planning efforts
- ▶ Crisis action (or during-exercise) use could be feasible with continued development to make quick-turn, rapid-responses possible
 - Familiarization with PMESII models & outputs
 - Dedicated resources & command emphasis
- ▶ Continue investigating PMESII M&S for strategic education

Take-Aways

- ▶ Complex operational environment requires new approaches & tools
- ▶ PMESII is part of curriculum and exercises at USAWC; beginning to leverage emerging PMESII tools
- ▶ DIME / PMESII / Irregular Warfare modeling & analysis is an emerging field; community is growing...
 - Modeling & Simulation Coordination Office
 - PMESII Center of Excellence
 - JS J8 Irregular Warfare system dynamics framework
 - Modeling efforts
 - JFCOM / BAH / Simulex IGS – SEAS integration
 - National Simulation Center JNEM
 - Northrop Grumman CELTS
 - Others...

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▶ JFCOM

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The **Integrated Gaming System** provides an integrated suite of tools that support Adaptive Planning, Wargaming, and Warfighting Analyses using DIME/PMESII construct

Integrated Gaming System Core Tool Suite

Scenario Tool

Rapidly create Order of Battle (OOB) file, including units, weapons, systems, sensor information, logistics, and comms networks



CPRS - Campaign Planning & Rehearsal System

Allows COA/plan development, map display, and a preview of operations, including rapid adjudication of COAs



EBW - Entropy-Based Warfare™ Model

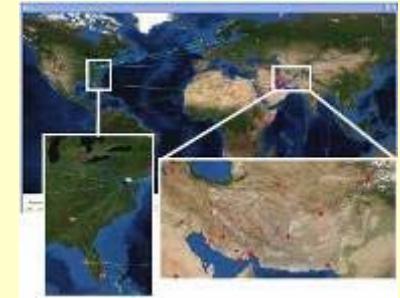
Detailed, campaign level analysis of potential Red and Blue COAs/plans



Embedded Irregular Warfare Functionality

NEXS - Network Exchange Simulation

Models asset and communication networks of various sizes and types, prioritizes targets, and applies HUMINT assets



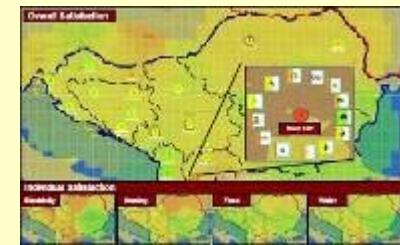
Political Will

Assesses complex agendas and support for specific policies among stakeholders and reactions to events over time



STARS - Stabilization and Reconstruction System

Models local population needs (food, water, etc) and the ability to satisfy them with in-theater infrastructure and capabilities



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Synthetic Environments for Analysis and Simulation (SEAS) is an Agent-based model that incorporates PmESII Interactions

simulex synthetic environments for analysis & simulation

SEAS-VIS 2008 Capabilities

Multi-layer, Multi-Granularity, Comprehensive

SEAS VIS is a representation of 62 countries

Represents

- Political Nodes
- Military Nodes
- Economic Nodes
- Social Nodes
- Information
- Infrastructure

- 7000+ Named Organizations
- 1200+ Named Leaders
- 20,000+ Named Infrastructure Nodes
- 500+ Named media nodes

12 Million Active Agents

SEAS - Synthetic Environments For Analysis & Simulation

Actions

- Diplomatic
- Information
- Military
- Economic

A synthetic "world" is constructed using over 100 million entities and their interactions, including economic, political, social, military, and infrastructure components, and receives inputs from the real world through sensors, providing data from thousands of public domain data sources.

Synthetic World

The Synthetic World consists of six interconnected domains: Political, Military, Economic, Social, Information, and Infrastructure. Each domain contains numerous nodes representing entities and their interactions.

Effects

The effects of the synthetic world are represented as geographic and temporal visualizations. The top row shows a world map with colored regions (green, yellow, red) representing different states or conditions. The bottom row shows zoomed-in views of specific regions, with the left one showing a temporal progression and the right one showing a spatial-temporal perspective.

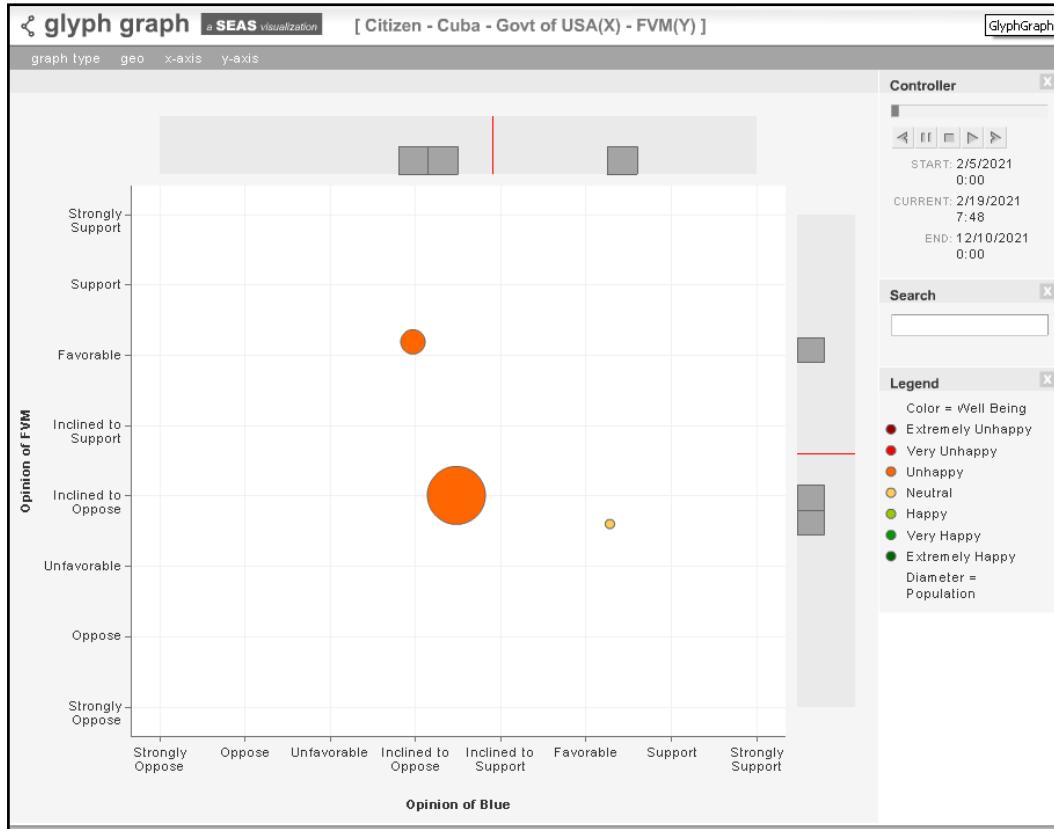
SEAS is capable of multidimensionality representation of space and time. SEAS geographic resolution ranges from 10m to neighborhood and the temporal granularity ranges from seconds to hours.

- ▶ SEAS integrates Non-State Actors, such as terrorist networks, black market economy, and competing insurgent groups.
 - ▶ Demonstrates media and propaganda's influence on public opinion
 - ▶ Illustrates prevailing local attitude towards Red, Blue, and Green forces

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Cuban Attitudes and Well-Being Feb – Dec 2021

Build slide thru time... ideal result is down (opposing enemy) and to the right (supporting ruling govt)



US military intervention causes drop in citizen attitude, but recovery efforts and media operations result in citizen attitude improvement toward US over time.

Enemy actions cause a drop in citizen attitude toward enemy that does not recover. This is also due to extensive Cuban and US led efforts to delegitimize enemy through relief aid and media operations.



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